Biological Evaluation of Ash Trees at Shenango River Lake and Dam

Prepared By:

Richard M. Turcotte
Entomologist

Craig Larcenaire
Student Trainee Biological Sciences

Kandace Burton
Student Trainee Forestry

USDA Forest Service
Northeastern Area State and Private Forestry
Forest Health Protection
180 Canfield Street
Morgantown, WV 26505

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Abstract
During the summer and fall of 2014, personnel from the U.S. Army Corps of Engineers, Pittsburgh District joined Forest Health Protection personnel from the Forest Service, U.S. Department of Agriculture, Northeastern Area State and Private Forestry Field Office in Morgantown, WV, to conduct a survey to detect emerald ash borer (EAB), *Agrilus planipennis* (Coleoptera: Buprestidae), at the Shenango River Lake and Dam (SRLD) in Mercer County, Pennsylvania, and Trumbull County, Ohio. The purpose of the survey was to see if EAB is present and determine the need for management activities in the SRLD. Since EAB has been found and is actively impacting the ash resource, we recommend that the SRLD develop a comprehensive ash management plan and that a chemical suppression/prevention treatment plan be put into place to protect high-value ash (*Fraxinus* spp.) trees. We also recommend the release of biological control agents.

Purpose and Need
The Forest Health Protection unit of the Forest Service's Northeastern Area State and Private Forestry Field Office (MFO) in Morgantown, WV, received a request from Kyle Kraynak, Resource Specialist with the U.S. Army Corps of Engineers (COE), Pittsburgh District, who was concerned about declining ash within the Shenango River Lake and Dam (SRLD). The MFO addressed the request to investigate SRLD for signs or symptoms of EAB and identify any significant issues that might occur as a result of borer activity within the SRLD. The MFO also evaluated what management options are available to protect and maintain the ash resources at the SRLD.

Project Location Description
Shenango River Lake and Dam is located in northwestern Pennsylvania in Mercer County, Pennsylvania, and Trumbull County, Ohio (41º15'N, 80º27'W). This COE project covers approximately 15,000 acres (figure 1). The project was authorized by an Act of Congress in 1938 as part of a flood damage reduction project in the Pittsburgh District. This project is part of a flood control system for the Beaver and upper Ohio River system.

Shenango River Lake and Dam lies in the beech-maple forest type (Rhoads and Block 2004) within the Erie Drift Plain U.S. EPA Level III ecoregion (http://www.cec.org/ecosystems). This area is dominated by sugar maple (*Acer saccharum* Marsh.) and American beech (*Fagus grandifolia* Ehrh.), with some elm (*Ulmus* L.) and ash (*Fraxinus* L.) swamp forests growing in the damper lowland areas (Wiken and others 2011).

Most of the SRLD is open to the public for recreational activities such as hunting and fishing. One area is managed for the Americans with Disability Act (ADA), which includes accessible hunting opportunities. A 3,500-acre lake offers fishing and water sport activities with an ADA accessible fishing pier at Clark Recreation Area. Camping is available with shower houses, restroom facilities, and a dump station as well as 330 campsites, many of which are equipped with electric hookups. There are seven pavilions that can be used by the public for special events. There is a public use swim beach located on the SRLD off of State Route 846. Self-guided nature trails invite visitors to experience the beauty of the SRLD area. The ½-mile Seth Myers Trail and the ¼-mile Coonie Trail offer an opportunity to learn about various habitats and the relationships between plants, animals, and humans. An 8-mile section of the Erie Canal Tow Path, the Shenango Trail, is also used by many hikers and is open to equestrian use. There are three fee boat

launch areas, three non-fee ramps, and four canoe ramps. A 200-acre riding area is available for off-road riding at the Bayview Recreation Area. In addition the SRLD has 2.4 miles of paved Rails to Trails walking/bicycle trail. The last covered bridge in Mercer County, Pennsylvania, is located at the Kidd's Mill area on the SRLD near the trail head for the Shenango Trail.

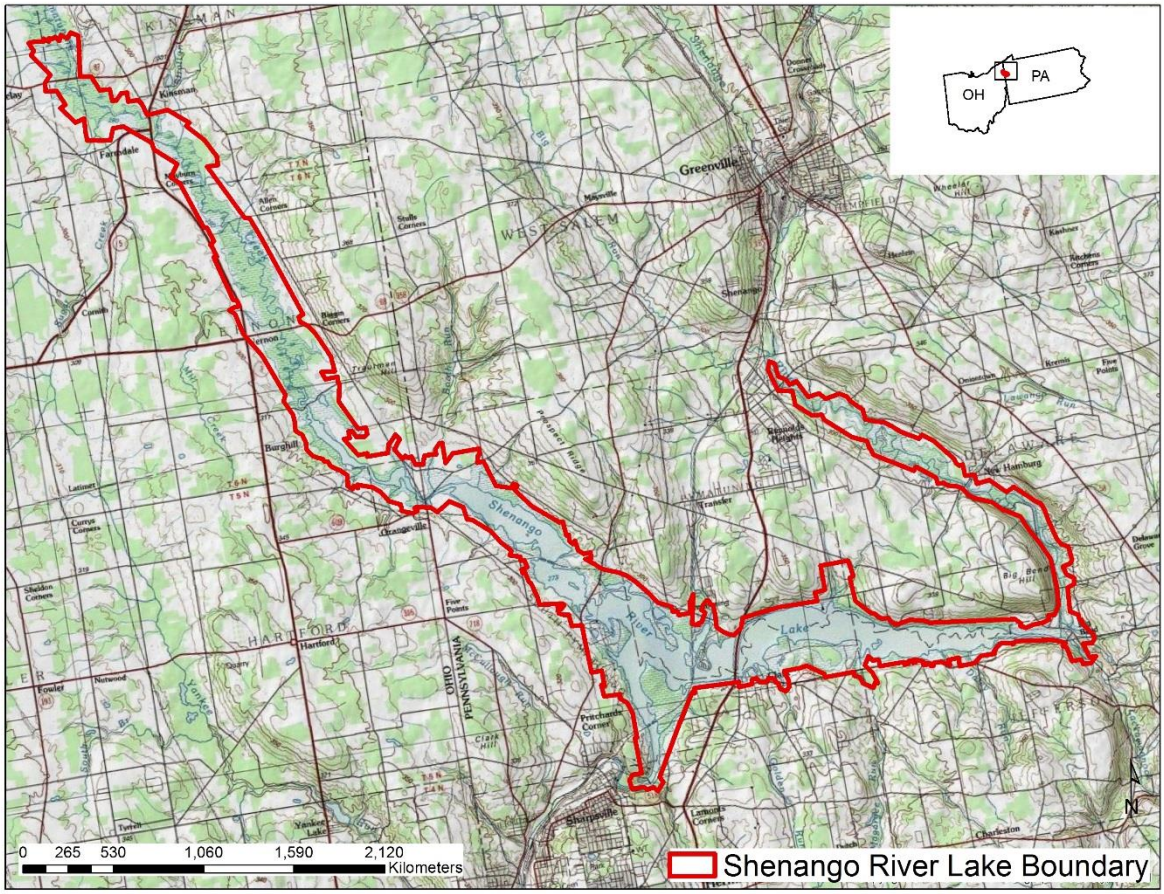

Figure 1. Shenango River Lake and Dam in Pennsylvania and Ohio.

Project Objectives

The objectives for this evaluation were to 1) determine whether or not EAB was present and active within the project, 2) assess the location and extent of ash within the project, and 3) determine the need for ash treatments to protect and maintain the ash resources within the SRLD.

Project Methods

ARCMAP Data

We used ARCMAP® data provided by the U.S. Army Corps of Engineers for the boundary and worked with COE staff to digitize and break the area into blocks based on use (e.g. campgrounds; figure 2). These boundary areas were then overlaid with National Agricultural Imagery Program data and Google earth imagery, which were used to digitize tree cover, calculate acreage, and define survey blocks. In addition we used Forest Service Forest Health Technology Enterprise Team 30-m resolution ash host data (http://www.fs.fed.us/foresthealth/technology/) to help identify the location of ash within the SRLD (figure 3).

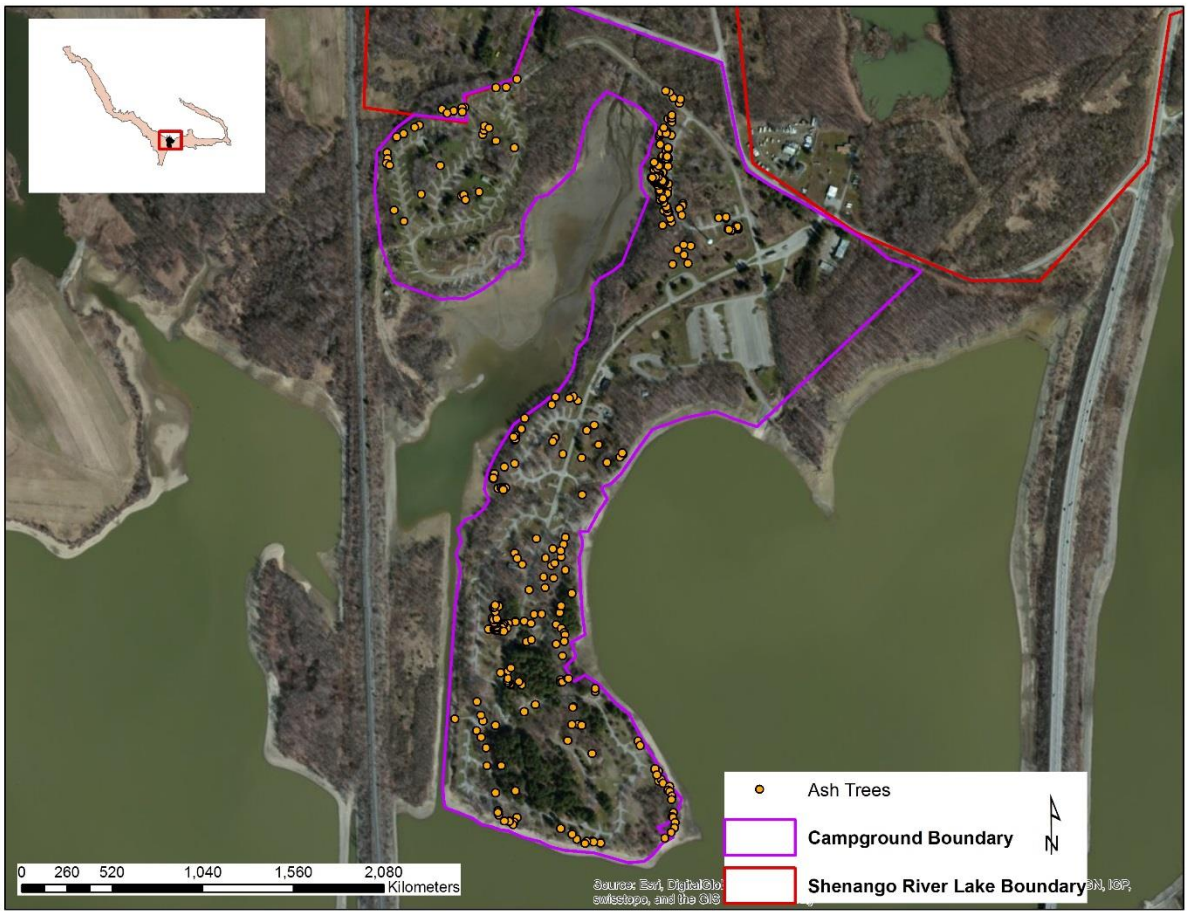

Figure 2. Survey map for ash trees at Shenango River Lake and Dam Campground.

The information used in this ash host layer was gathered from satellite imagery and Forest Service Forest Inventory and Analysis data. These data were then modeled to create a 30-m^2 grid map representing the amount of ash basal area predicted to be present within the SRLD (figure 2).[1] Note that the darker the shading in figure 3, the greater the amount of ash basal area predicted to be present.

Ash Survey

In the summer and fall of 2014, SRLD and MFO staff conducted an intensive ash inventory of the campground (figure 2). All ash trees ≥ 1 inch in diameter at breast height (d.b.h., measured at 4.5 ft. above the ground) were identified; assigned a size class; visually inspected for signs and symptoms of EAB (e.g. woodpecker activity, D-shaped exit holes, serpentine galleries); and had their geocoordinates recorded using a hand-held GPS unit.

[1] Basal area is a common term used to describe the amount of area occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height (4.5 ft. above the ground) (U.S. Department of Agriculture 2001) and is expressed as per unit of land area (typically square feet per acre).

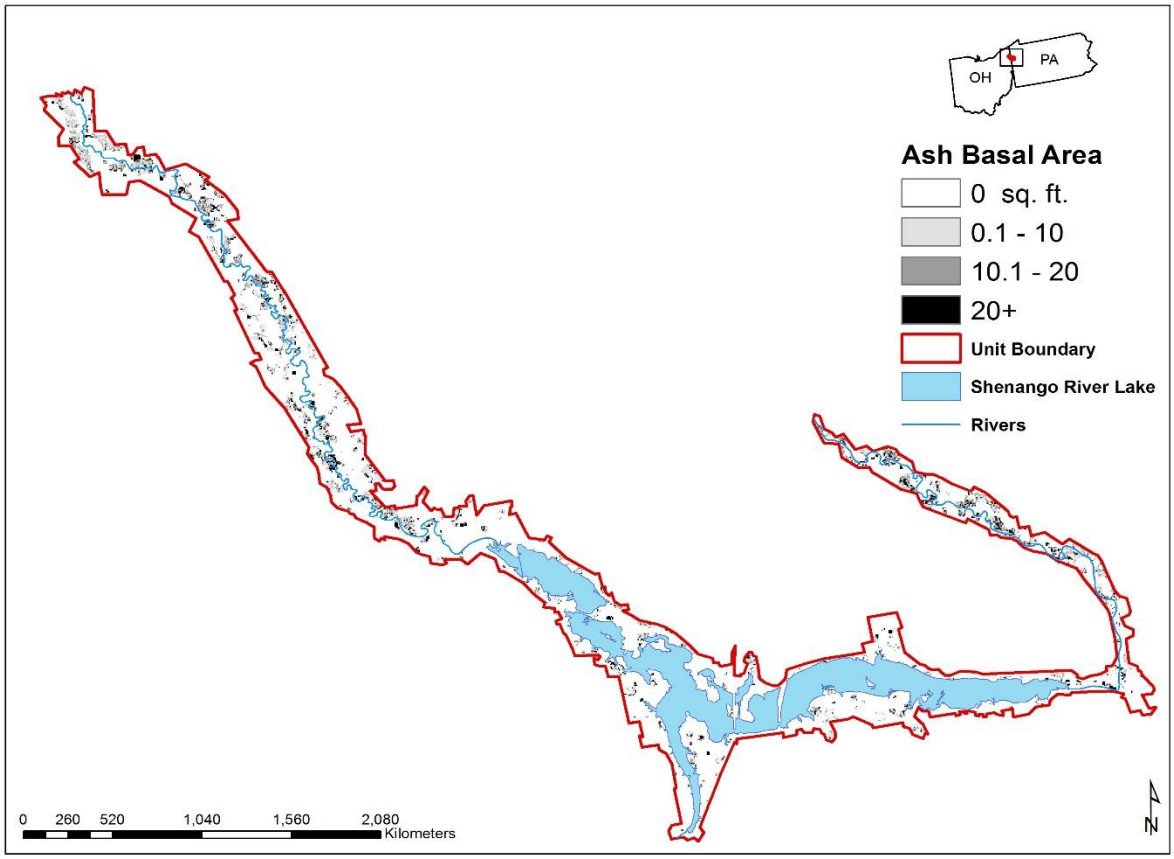

Figure 3. Forest Health Technology Enterprise Team predicted ash basal area, measured in square feet per acre, in the SRLD.

Results

Ash Tree Survey

The emerald ash borer was found to be present and causing tree mortality at the SRLD campground. Field surveys identified 478 ash trees within the campground (figure 2). Of the 478 ash trees inventoried, 440 were alive and 29 were dead. There were nine ash stumps present, which was the result of ash mortality from EAB attacks. The average d.b.h. for live ash trees was 9.0 ± 7.0 inches (figure 4); live trees ranged in size from 1.0 to 44.0 inches d.b.h. Woodpecker activity was noted on 5.4 percent of the tallied ash trees, and D-shaped exit holes were found on 15.9 percent of the ash trees. In total, it is predicted that at least 22 percent of the ash surveyed in 2014 at the SRLD campground are infested with EAB (figure 4). This is likely a significant underestimate because EAB is difficult to detect during the early stages of attack on a tree.

Ash Basal Area

A total of 68,384 30-m^2 grid cells were mapped within the SLRD boundary; of these, 8,866 cells (roughly 2,000 acres) are predicted to have ash present. This equates to about 13 percent of the SRLD area containing ash trees.

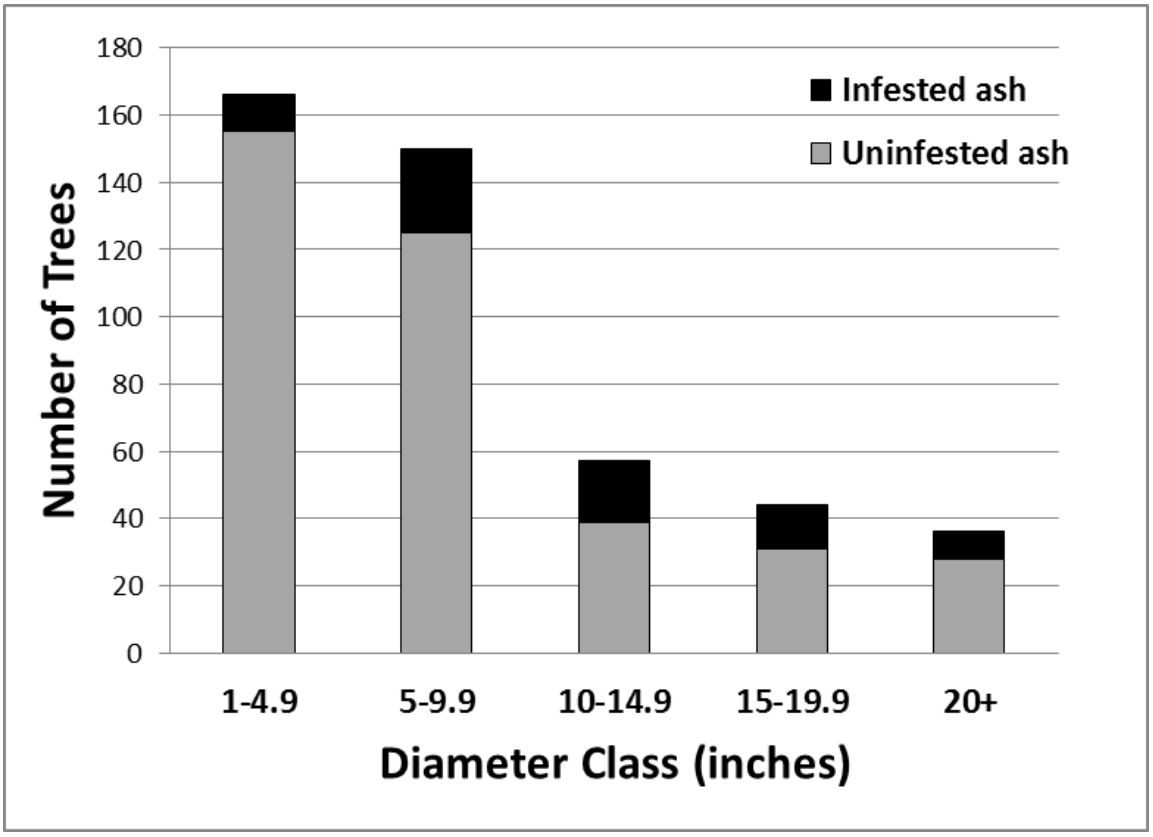

Figure 4. Size distribution of ash within the campground at Shenango River Lake and Dam.

Discussion

The main objectives of this evaluation were to determine whether EAB was present, inventory the area, and evaluate the need for EAB management activities. Because EAB is currently present and active at the project, we recommend that the SRLD develop a comprehensive vegetation management plan that includes preemptive ash removal (e.g. removal of ash with poor form or defects, or removal of ash to lessen EAB population buildup); chemical treatments; removal of infested ash trees (e.g. hazard trees and trees beyond the chemical treatment stage); biological control releases; and replanting to ensure that a sustainable forest will continue at SRLD.

Management Alternatives

For 2015, three options have been evaluated for managing EAB at the SRLD. The intervention options are offered based on the following objectives: 1) protect high-value ash trees and 2) protect native woodland ash trees. Each option is discussed below.

Alternatives

Alternative 1.	No action
Alternative 2.	Treat all landscape and campground ash trees and release biological control agents.
Alternative 3.	Limit treatments to all landscape and campground trees >15 inches d.b.h. and release biological control agents.

No Action Option

In this option emerald ash borer is allowed to infest susceptible ash trees within the project. Should this option be selected, it is likely that all susceptible ash trees would be attacked and die as a result of EAB. This would result in the loss of not only high value trees but native woodland trees which would result in hazard trees in public areas, and a reduction in overstory canopy and soft mast production in these areas.

Intervention Options

Chemical Insecticide Option

The second and third options involve using chemical insecticides to prevent and control EAB. Herms and others (2014) reviewed chemical control options for EAB, which include noninvasive systemic basal trunk sprays, soil-applied systemic insecticides, trunk-injected systemic insecticides, and protective cover sprays.

- Dinotefuran (Safari®) is labeled for controlling EAB and has shown variable results. It is sprayed on the lower 5 or 6 feet of trunk.
- Soil injection of imidacloprid has shown variable results and requires careful attention to soil conditions and tree d.b.h. Soil injections should be applied 2-4 inches below the soil surface to stay available to feeder roots, the soil should be moist to facilitate uptake, and chemical amounts should be increased or combined with other treatment methods for trees larger than 15 inches d.b.h.
- Trunk injection of emamectin benzoate in mid-May or early June provides the most consistent control of EAB, according to test trials at Michigan State and Ohio State Universities. This was the only treatment that provided multiple years of protection (up to 3 years).
- Protective cover sprays have been shown to prevent EAB from entering trees in Michigan State University studies, but have no effect on larvae feeding under the bark. Spraying the entire tree is most effective, but there is considerable drift associated with this process.
- A natural product, azadirachtin, is also available formulated as TreeAzin™, which has the potential for systemic control of EAB. This product is a natural tetranortriterpenoid compound extracted from the seed kernels of neem (*Azadirachta indica*) (Fares and others 1980) and is injected into the trunk of the tree.

Biological Control

Currently, three parasitoid wasps, including two gregarious larval endoparasitoid species (*Spathius agrili* and *Tetrastichus planipennisi*) and a solitary parthenogenic egg parasitoid (*Oobius agrili*) are available for release against EAB. The release and establishment of EAB natural enemies is not likely to provide any short-term control of EAB. This long-term approach is still experimental and will likely require a complex of natural enemies to maintain EAB below damaging levels. It may be years before these parasites can perpetuate themselves sufficiently before any level of success can be determined.

Recommendations

Because EAB is already active at the SRLD, we recommend that the SRLD develop a comprehensive ash/forest management plan and put a chemical suppression/prevention treatment plan into place as soon as possible. In addition, we recommend that the SRLD begin a public awareness campaign about EAB.

We recommend Alternative 2 based on the following considerations:

1) The high number of ash trees infested by EAB at the SRLD.
2) This alterative protects high-value ash trees and retains both large and smaller specimen trees.
3) We also recommend releasing available EAB parasitoids in infested areas that are not in proximity to chemical treatments. The establishment of these natural enemies is experimental, but may offer the opportunity for long-term control and may minimize the need for repeated chemical treatments in future years.

Species Evaluation

Emerald ash borer (EAB), *Agrilus planipennis* (Fairmaire), is a wood-boring beetle from Eastern Asia (Poland and McCullough 2006) that is causing severe mortality in North American ash (Tluczek and others 2011). EAB affects all species and diameter classes of ash and often kills both healthy and stressed trees within 3 to 5 years of their becoming infested (Siegert and others 2006).

Based on data from the USDA Animal and Plant Health Inspection Service, EAB emerges around mid-June and is present through mid-August (www.emeraldashborer.info). Adult beetles are slender, elongate, and bright green, and feed on ash foliage in patches along the leaf margins (Kovacs and others 2010). Adult beetles usually live for about 3 weeks, and females lay about 60-90 eggs (McCullough and Katovich 2004). Eggs hatch in 7-10 days, and larvae chew through the bark and feed on phloem and outer sapwood for several weeks, creating S-shaped galleries packed with frass (Bauer and others 2004). Larvae are white to cream colored, have 10 segments, and are flattened. Larvae overwinter in shallow chambers in the outer sapwood or bark on thick-barked trees (Bauer and others 2004). EAB pupate in late April or May, and adults emerge 1-2 weeks after pupation through D-shaped exit holes (McCullough and Katovich 2004).

In addition to causing severe economic damage, there are ecological consequences associated with the loss of ash from North American forests. Studies show that ash trees provide food and habitat for several bird and mammal species (Faanes 1984, Rumble and Gobeille 1998). Forty-three native arthropod species are at high risk due to their association with ash for breeding or feeding (Gandhi and others 2010). Ash also contributes to nutrient cycling in hardwood forests (Reiners and Reiners 1970).

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